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# FROM ISLANDS OF INNOVATION TO CREATIVE HOTSPOTS

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**Abstract**

Key innovation areas are a source of policy and research interest in many countries. In this paper the concept of 'creative hotspot' is introduced as a policy vehicle to support spatial synergy strategies in innovation. The paper provides a review of experiences and findings from a regional innovation performance assessment in the Eastern part of the Netherlands. Its methodology is based on the Technopolicy Network model (TPN model). The study compares the (potential) performance of this hotspot in East Netherlands with three other hotspot regions. Various findings are briefly summarized in the context of a systematic 'creative hotspot' SWOT analysis. The results from this SWOT approach are then used to provide an input for a systematic evaluation of new innovation policy in East Netherlands and to identify future challenges and opportunities for regional innovation policy.

**Key words:** Regional innovation; Clusters; Technopolicy Network model; Creative hotspots; Islands of innovation; SWOT analysis

**Acknowledgement**

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## 1. Creativity: The Cornerstone of Innovation

Our world - with its limited resources and its ever growing population – is faced with many knowledge and policy challenges that call for new modes of thinking and acting. A sustainable future development presupposes adequate and timely responses to issues like urbanization, mobility, environmental decay, water management, food production, energy resources, globalization and technology. Innovation is often seen as a *sine qua non* for coping with these challenges. Although the need for innovation strategies and policies is broadly accepted – thanks in particular to the seminal contributions of Schumpeter (1938) in the last century –, there is still much uncertainty on the 'what' and 'how' of a successful innovation expedition. Clearly, innovation implies that things are realized better, cheaper and faster, so that productivity and efficiency in a competitive environment are enhanced (see also Acs et al. 2002, de Groot et al. 2004, Capello and Nijkamp 2009, and Fagerberg et al. 2005). Innovation may also unlock new opportunities in technology or markets, that were unheard of before. But innovation is no 'manna from heaven': it calls for dedicated efforts in which entrepreneurship, knowledge transfer and valorization, as well as business leadership are critical success conditions.

In this context, various innovation models have been put forward, such as the *open innovation model* and the *cyclical innovation model.* The open innovation paradigm abandons the traditional top-down 'linear' innovation perspective in which knowledge supply is supposed to facilitate innovation results through a knowledge-filtering approach towards the industry. Open innovation is – on the contrary – based on a bipolar relationship between the knowledge sector and the industry, with a clear role for demand articulation. A further extension of this concept can be found in a triangular structure incorporated in the Triple Helix model linking the knowledge sector, industry and governments (see Etzkowitz and Leijdesdorff 1997). The cyclical innovation model presupposes that various stakeholders in the innovation process are interlinked through various formal and informal networks which address four tasks: scientific research, technological development, creation of new products and services, and market introduction ('customer value'). The cyclical innovation model is based on both feedback and feedforward linkages for knowledge circulation, and includes all stakeholders in the innovation chain.

These developments in innovation management run parallel to new advances in modern economic growth theory, in particular the emergence of the new (endogenous) growth theory (see e.g. Stimson et al. 2010), in which the promising success factors for innovation (such as knowledge or entrepreneurship) are not seen as exogenous forces but rather as endogenous outcomes of a complex multi-actor economic system in a competitive environment. Furthermore, we see also a striking correspondence with the traditional theory of industrial districts (see Marshall 1890), which has seen a rejuvenation in the modern new economic geography (see

Fujita and Thisse 2002). This new strand of literature pays particular attention to the agglomeration forces as main determinants of competitive performance in an open trade system. Indeed, the spatial dimensions of innovation systems have in recent years received increasing attention.

Regional economic growth policy – in a broad developmental context – has exhibited many conceptual and operational policy appearances, reflected in concepts like growth poles, development corridors, industrial complexes, communication axes, innovation milieus, knowledge poles or brainports. Despite some variation in meaning and scope, all these concepts take for granted that economies of scale, scope, knowledge and geography are the basic conditions for an accelerated growth path of an area. This holds also for the more recently developed concept of 'islands of innovation'.

*'Islands of innovation'* may be seen as a contemporaneous concept that encapsulates the new innovation theory (see Acs et al. 2002) from the perspective of geographically determined innovation advantages including local networks and open access to modern technology (see FAST 1992, Cooke et al. 2000). It is a variant of the 'innovation milieu' concept introduced by the GREMI group (see Camagni 1995), in which knowledge and innovation are supposed to be generated by local cooperative learning processes, which in turn are fostered by spatial proximity, network relations, socio-cultural interactions and creativity (creativity in which we create totally new things, do old things in new ways, introduce of novel elements into an established domain (see Lim, 2004)).

. In the same vein, islands of innovation offer a relational space in which functional and hierarchical, economic and social interactions take place that are embedded in 'active geographical space' (see Caragliu and Nijkamp 2010). This 'milieu' acts as a cognitive engine that triggers innovation by reducing uncertainty and information asymmetry and by inducing synergy and interaction. Islands of innovation are based on a competitive human capital endowment which is offered by economic core regions with a high knowledge intensity. These areas offer spatial singularities where innovative activities tend to concentrate in a way analogous to a Marshallian concentration of innovative firms in spatial clusters (see Bagchi-Sen and Lawton-Smith 2008 for an applied study on the concentration of the Indian biotechnology sector).

In a modern, open network society such a 'splendid isolation' of islands of innovation may also have intrinsic drawbacks, as this may hamper openness and trade, one of the critical determinants of economic growth. This means that essentially the concept of agglomeration advantages – the cornerstone of location theory and new economic geography – will have to be extended by a spatial synergy component for islands of innovation. This spatial network component represents the network linkages with other nodal development areas, so that a higher-

level of economic synergy may be achieved. Such a network configuration among individual nodal areas which generates an additional added value compared to the conventional economies of scale and scope in a given island of innovation will be called here a '*creative hotspot*'. A creative hotspot derives its innovation and growth potential from three sources:

- Economies of *density* in a given agglomeration (e.g., an island of innovation, a metropolitan knowledge region);
- Economies of *synergy* through connectivity with other agglomerations or knowledge nodes as a result of complementary resources in these areas;
- Economies of *linkages* in satellite locations through specialized supply of or demand for customized goods that are not available in the core agglomerations themselves.

The idea of a creative hotspot ties in with the recent ideas on creative industries and creative cities (see Florida 2002 and Landry 2003). Creativeness is a cognitive ability that may lead to new ways of thinking and acting. Especially the socio-cultural diversity in modern urban areas may act as a cradle for innovation, an idea that was inspired by the well-known 'melting pot' hypothesis of Jane Jacobs (1961). Creativeness is thus a source of productivity increase in urban areas through a combination of knowledge resources, openmindedness and entrepreneurial ability.

This creative hotspot concept is increasingly seen as a strategic vehicle through which cooperation and synergy in regional development policy can be achieved. Clearly, all relevant stakeholders (industry, government, knowledge institutions, intermediate agencies) have to be part of such a creative hotspot strategy. We will now outline in the next section the analytical approach and the empirical case study addressed in the present paper. Then we will address the application in our study, positioned in the Eastern part of the Netherlands, where we will illustrate the concept of creative hotspots based on three cluster initiatives each incorporated in an island of innovation. We will then employ a benchmarking analysis based on a SWOT approach to assess the growth potential of this creative hotspot, also in comparison with other hotspot regions.

## 2. Methodology and Policy Case Study: East Netherlands

Knowledge intensity and network constellation have in recent years adopted a prominent place in regional economic analysis (see van Geenhuizen en Nijkamp 2011). A great variety of both conceptual and policy-oriented studies has been published over the years highlighting the strategic importance of connectivity among clusters of innovation (see e.g. Keeble et al. 1998, Keeble and Wilkinson 1999, 2000, Lawton-Smith 2004, 2007, Lawton-Smith et al. 2005, 2008).

A strategic analytical instrument to map out and access the complex force field of innovation in knowledge clusters is provided by the so-called Technopolicy Network (TPN) model, which is represented in a simplified form in Figure 1. This model may be helpful in identifying the key handles for regional innovation policy (see also Nijkamp et al. 2011).

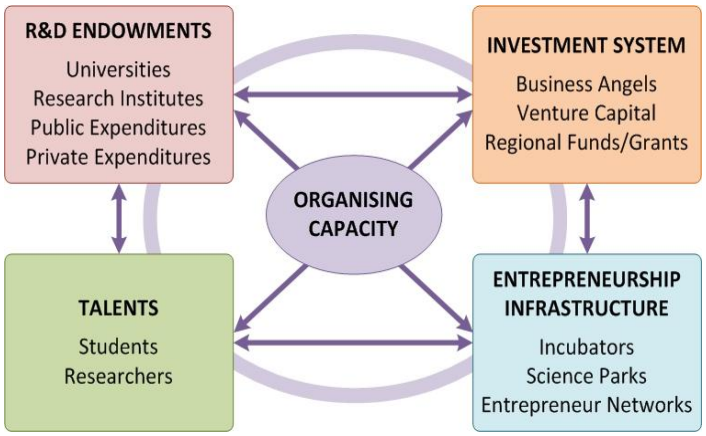



**Figure 1.** Condensed version of the Technopolicy Network (TPN) model for active geographical space

The current economic and financial crisis has not only affected macro-economic developments in all countries world-wide, but is also increasingly visible at regional and local scales. Against this background, it is no wonder that regions are increasingly prompted to seek for a critical assessment of their strategic objectives and policies. Regions are no islands in isolation, but are clearly subjected to tidal movements of an open and globalizing economy. And consequently, many regions try to develop appropriate responses to such global economic challenges.

The provinces of Gelderland and Overijssel in the Eastern parts of the Netherlands have recognized the need for a timely reconsideration of their strategic economic and innovation policies in order to judge whether unanticipated global developments necessitate the design of amended policy strategies. The regional policy of these two provinces – with a rather peripheral location in the Netherlands – used to be developed rather independently from each other, but in the past decade these provinces have rather successfully tried to join hands and to mobilise common forces in order to reinforce their national and international position. From this perspective, much attention has been given to innovation and knowledge strategies as a *sine qua non* for (inter)national competitiveness. The two provinces house three important and recognized knowledge institutes, viz. Twente University of Technology (in Overijssel), Radboud University and Wageningen University (in Gelderland). And therefore, it was plausible to centre innovation and valorization activities around these three knowledge centres. Each of these clusters might

then form the cornerstone for broader business spinoffs, which may then be incorporated in an island of innovation. The synergy among these three islands might then lead to the creation of an important innovation triangle – essentially, a creative hotspot – connecting these three cluster initiatives.

In the light of the economic downturn, the question has been raised whether a drastic intensification of these initiatives would not only be timely, but even necessary. The emphasis would have to be placed on new modalities for generating a higher added value from individual regional innovation strategies. In other words, is it possible to enhance the socio-economic and technological achievements of both provinces by combining the existing or emerging islands of innovation rigorously into a creative hotspot?

To this end, we will develop a multi-layer benchmark study on the innovation performance of the most important knowledge-intensive cluster initiatives in the Eastern part of the Netherlands (i.e., the provinces of Gelderland and Overijssel), and discussed from both an analytical and a organized policy initiative perspective. Such islands of innovation should be based on critical economic mass in a geographically condensed space, on the introduction of a broad thematic focus and on embeddedness in an international network. But at the same time these initiatives should be firmly anchored in the existing regional economy with a complex network of cities. The largest cities in this region include Arnhem (capital of Gelderland), Nijmegen, Enschede and Zwolle (capital of Overijssel). However, the two capitals Arnhem and Zwolle do not have a university, and consequently the most important and knowledge-intensive clusters initiatives ('islands of innovation') are mainly situated in Nijmegen (Health Valley), Wageningen (Food Valley) — in the province of Gelderland — and Enschede (Technology Valley) — in the province of Overijssel. The alliance of these three cluster initiatives as a cooperative network is sometimes coined the East-Netherlands 'Triangle', with a central theme around the concept of 'healthy people'.

The important key players in the regional innovation system of the East-Netherlands region include the University of Twente, Wageningen University and Research Centre, and Radboud University Nijmegen, with three successive cluster initiatives around the three themes and three regions: Food Valley (Gelderse Valley), Health Valley (Nijmegen/Arnhem) and Technology Valley (a city band in the region of Twente around the cities Enschede, Hengelo and Almelo). We have selected in our actual case study research the following three important cluster initiatives of very high innovative and economic content: Health Valley (Nijmegen region), Food Valley (Wageningen region) and Technology Valley (Twente region) (see Figure 2).

Wageningen University has a high international standing in agriculture, food and health research; it is a small university but internationally-oriented with more than 50 per cent of its students coming from all over the world. Next, Radboud University in Nijmegen has a regional specialization in theoretical physics and medical science. And the University of Twente, which is very close to the German border and has many German students, has a strong specialization in nano technology and medical technology.

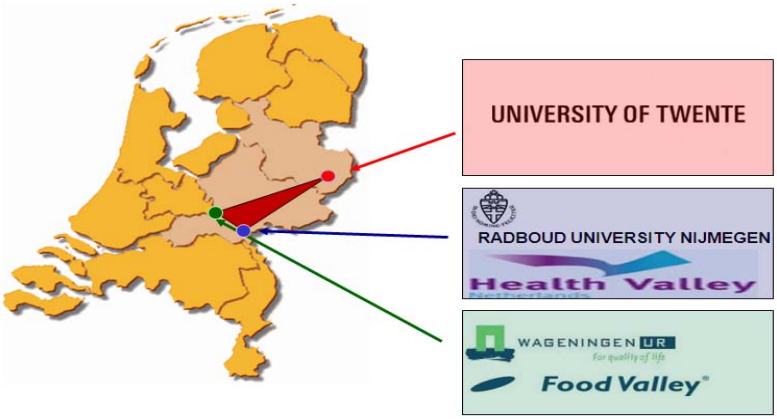



**Figure 2.** A triangle of universities and three innovation clusters in the East Netherlands

The methodology for achieving information, analyses and recommendations for this case study is based on expertise of 3 highly qualified international experts; literature review of available public policy documents, interview with 49 with representatives from various stakeholders, knowledge institutes, universities, and policy making bodies; and Technopolicy Network (TPN) model and benchmarking three International Regions

## 3. Islands of Innovation in the East Netherlands

### 3.1 A general sketch

All ‘actors of science’ in the Eastern part of the Netherlands have their own merits. They have been rather successful in creating many spin-offs: an intensive spin-off policy of the universities and a broad range of entrepreneurship facilities resulted in hundreds of new firms created around these centres of science and research. Industrial actors became increasingly involved in these science clusters. They made big investments and ambitious investment plans for the future. Also the regions themselves were actively involved. Some of these clusters have tried use a jargon from marketing science, as a branding principle. For instance, the University of Nijmegen has called itself ‘Health Valley’, the University of Wageningen baptized the

surrounding area 'Food Valley', and the University of Twente called its area 'Technology Valley'.

The use of the term 'Valley' clearly refers to the most important science-based innovation valley in the world, 'Silicon Valley', which is the cradle of internet and modern IT industry with companies such as Hewlett Packard, SUN (Stanford University Networks), Google and Yahoo and which has a strong science base with several universities such as Stanford University and University of California, Berkeley. Policy makers across the world look enviously upon the Silicon Valley success and by mirroring themselves with it, they try to copy its economic organisation structure (examples are 'glanny valley' in Scotland, Medicon Valley in Denmark, Solar- and Medical Valley in Germany, 'polder valley' in the Netherlands, etc.)

At this point, the main question to be addressed is whether the sum and interlinkage of these three islands of innovation is sufficient to become and stay strong in a changing international development? To give an idea on where these individual cluster initiatives stand and whether policy makers should continue to invest in these valleys in order to enhance their European and international position, we will evaluate their performance using the above multi-parameter TPN model, analyse them in terms of their 'pluriformity' characteristics (knowledge creation, spin-off, innovation, creativity, etc.), and identify future challenges and opportunities for regional innovation policy.

### 3.2 Inventory and analysis: Health Valley

*Description*

The regional economic activity of Health Valley is situated between the University of Twente and a town called Oss (base of MSD – Merck Sharp & Dohme –, former Organon), with the University Medical Centre (UMC) St. Radboud in Nijmegen as a central junction. The highest intensity of cooperation takes place between UMC St. Radboud and the University of Twente linking the studies of technical medicine and the med-tech institute MIRA in Twente with the UMC in Nijmegen. Furthermore, there is an alignment with MSD in Oss and Philips in Eindhoven[1]. The important regional actors, such as Nijmegen University, UMC St. Radboud, University Twente with its many spin-offs, the cluster organization Health Valley, and the multinationals NXP and MSD, play an important role in the regional innovation strategy of Health Valley.

[1] It needs to be noted that recently MSD, Oss has announced to stop its R&D activities in the Netherlands, resulting in a cut of almost 50% of its 4500 employees in the Netherlands; this will certainly represent a serious set-back for the Health Valley.

Health Valley is a network organisation that has as its ambition to stimulate corporate activity and the development of new products and services in the region through intensive collaboration between regional actors in the field of healthcare and health technology in four focal areas (molecule to man, reconstructive medicine, eHealth and healthy people). Recently, the Health Valley strategy was refined and its focus was sharpened under the name 'Red Med-Tech Highway', which links technological activities in Twente, Nijmegen and Eindhoven, and pharmacy activities (Red Biotech) in Nijmegen and Oss. Moreover, this concept foresees partnerships with the science-based innovative regions of Groningen (Netherlands), Leuven (Belgium), Aachen (Germany) and Münster (Germany). These satellite partnerships underline the ambition in the region that cooperation on innovation is not restricted to regional boundaries.

*Health Valley TPN Analysis*

The results in Figure 3 show the key factors of the innovation performance in the Health Valley region Nijmegen-Arnhem, as compared with the Triangle from Figure 2. Both curves are relatively quantified and normalised to the population within the region. The curves related to this island of innovation represent the innovative vitality and creativity of this region and its contribution to the urban innovation economy in this cluster. It can be used as a tool in the development of appropriate strategic policies for the cluster initiative on Health Valley.

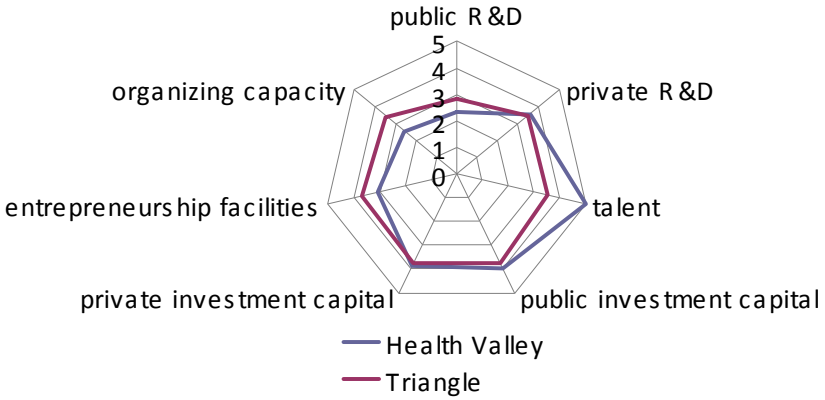



**Figure 3.** Health Valley TPN analysis

The score for the key factor '*private R&D*' originates for a disproportionate share from the multinational NXP (former Philips Semiconductors), which has some but not its major share of research activities in the medical field. R&D expenditures by MERCK, with private R&D expenditures of approx. 400 M€ in 2008 (being the third most R&D intensive company in the Netherlands), has not been included in the assessment in the light of the above announced closing of its R&D facilities in the Netherlands.

The key factor *'talent'* achieved a high score in the cluster Health Valley, mainly due to the presence of Radboud University Nijmegen, the high level of vocational and education institutes (with approx. 46,000 students and 7,000 employees) and a high total economically active population with higher education qualifications (41 per cent) (See Apendix Table A and B). This can be explained by the fact that the 'cultural and socio-ethnic pluriformity' situation in urban regions may induce various impulses which stimulate and attract the best and brightest (high-skilled) students to become and stay engaged in these regions by deploying urban space as an action platform and mobilizing all resources (e.g. culture, public employers).

The key factor *'entrepreneurial facilities'* stays behind in this cluster initiative, because of the small-sized science park, and the incompletely integrated services in the incubators. However, the impact of the factor will be improved considerably with the arrival of the new Novio Tech Campus and a second Life Science incubator of the UMC.

Finally, Figure 3 shows that the score of the key factor '*organizing capacity'* lags behind the other two cluster initiatives, mainly due to a low number of employees per cluster organization (excluding common resources of the East Netherlands Development Agency, Oost NV and the public SME organization Syntens). It should be noted that the position of 'organizing capacity' in Figure 1 and in the spider figures is different. In Figure 1 the focus is on the interconnectivity of the various factors involved in regional innovation organization. The Spider diagram shows only an assessment of the quality of each factor and not the interaction or linkage between those factors.

In Table 1, from a qualitative and quantitative stakeholders analysis various findings are briefly summarized in the context of a systematic SWOT (Strength-Weakness Opportunities-Threats) analysis for five key domains of interest for the innovation economy in the region Nijmegen and the cluster initiative Health Valley.

**Table 1.** A systematic overview of the various effects of the Health Valley

| **Strengths** | **Weaknesses** |
|---|---|
| S1: Large University Medical Centre (~7000 employees)<br>S2: New Strategy Med-Tech Highway, connecting Twente, Nijmegen and Eindhoven in the Med-Tech field<br>S3: Clear commitment of University Medical Centre to valorization of scientific research and contribute to regional economic growth<br>S4: Technical medicine is a new academic study developed as a collaboration between Twente and Nijmegen. This is a world-wide unique discipline with great potential | W1: Limited Med-tech development within the valley; therefore strongly dependent on technology from Philips (Eindhoven) and Twente University<br>W2: No common vision on strategic position of university complex<br>W3: Weak industrial basis in direct vicinity of the university; no well developed Science Park |
| **Opportunities** | **Threats** |
| O1: Open innovation initiatives with Philips and Siemens Medical Systems, may generate economic spin-off<br>O2: Coupling the med-tech highway concept with the national innovation agenda will make it the leading med-tech initiative in the Netherlands | T1 Twente and Nijmegen universities need become the central axis in the med-tech highway concept, but have very different cultures in terms of applied research & knowledge valorization |

### 3.3 Inventory and analysis: Food Valley

*Description*

The production of food, advanced knowledge about these processes and strong innovation initiatives in the agricultural and food sector are a national strength of the Netherlands. The epicenter of this Dutch strength can be found in the Food Valley (the southwest part of the Gelderse Valley in the Netherlands), with Wageningen, Ede and Barneveld coining the territory a food cluster, and where important actors for innovation in the Food Valley (e.g. international recognized knowledge institutes, such as Wageningen University and Research Center (WUR), Top Institute Food and Nutrition, NIZO Food research) are concentrated.

The foundation Food Valley is a cluster organization with a strong regional basis in the Gelderse Valley (or Food Valley). As a response to global trends and the economic recession, strategic planning of regional development infrastructure is accelerated to realize the 'Food Valley Ambition 2020' (viz. a combined spatial/economic planning effort of municipalities, the province, knowledge institutes and the private sector to boost the competitiveness of the Food Valley region).

*Food Valley TPN Analysis*

In Figure 4 we present the results of the multi-parameter TPN analysis for the 'Food Valley' cluster initiative (the island of innovation) in the region Gelderland as compared with the Triangle (the creative hotspot).

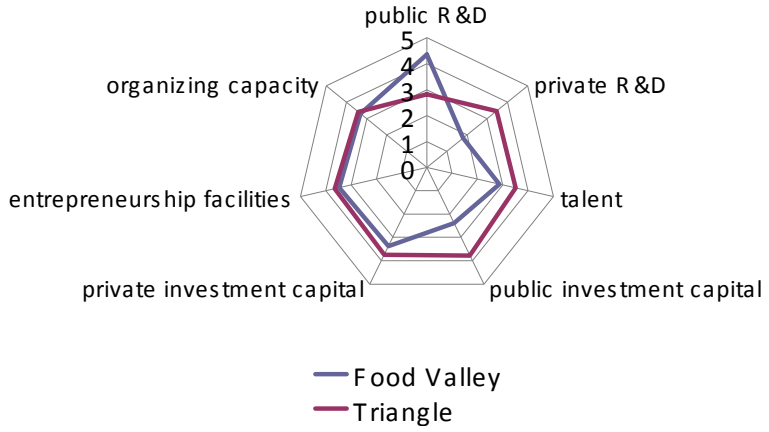



**Figure 4.** Food Valley TPN analysis

From the '*public R&D' score*, it can be concluded that this factor outperforms all other key factors in the Food Valley, with public R&D expenditures of approx. € 520 M. The reason

for this is that, being the Netherlands' only agricultural university, public R&D centres for agriculture are associated with this university. Wageningen is also in the unique position of receiving major R&D funding from two ministries, viz. science & education and agriculture.

The score on *'private R&D'* is significantly lower, as the region lacks large industrial actors. The largest corporate player in the Food Valley is Friesland Campina, a multinational producer of dairy products. The Danone R&D centre (former Numico) is established slightly outside the region in the neighboring province of Utrecht. Large Dutch multinationals in the field such as Unilever and DSM, however, are located in other locations in the Netherlands, leading to the paradox that the Food Valley is the centre of public R&D efforts, but private R&D efforts are much more evenly distributed throughout the country.

The key factor *'talent'* scores rather low, because of the small-sized university, with less than 7500 students and with only a few large employers in both the public and private domain, which explain the low graduate retention in the region of 33 per cent (See Appendix Table A and B). The score on *'public investment capital'* in the Food Valley is relatively low, as the average number of seed and pre-seed grants has been relatively low in recent years.

The performance of the region in terms of organising capacity, entrepreneurship facilities and private investments in entrepreneurship scores well compared to the average of the Triangle hotspot. This is because the university has a well developed knowledge valorization culture, a well-regarded cluster management organization and sufficient access to angel and venture capital.

In Table 2, from a qualitative and quantitative stakeholders analysis various findings are briefly summarized in the context of a systematic SWOT analysis for five key domains of interest for the innovation economy in the Food Valley island of innovation.

**Table 2.** A SWOT analysis of the Food Valley

| **Strengths** | **Weaknesses** |
|---|---|
| S1: Strong international position in agriculture related R&D<br>S2: Strong standing of the brand Food Valley<br>S3: Strong common vision among regional partners as defined in Food Valley ambition 2020 | W1: Though the centre of Dutch food R&D, not the centre of Dutch food business & industry<br>W2: No successful acquisition of companies to the region |
| **Opportunities** | **Threats** |
| O1: Prominent role for Dutch multinationals will lead to a stronger position<br>O2: Enhanced vision and collaboration within the region may render the region more attractive for foreign companies | T1 Insufficient attractivity and competitive potential of the region with other regions in Europe and the US, may harm the leading position of Wageningen University |

### 3.4 Inventory and analysis: Technology Valley

*Description*

The regional economic activity of Technology Valley is concentrated in the network city Twente with Enschede, Almelo, Hengelo, Borne and Oldenzaal as the important urban regions. The thematic focus of this cluster initiative is based on the industrial strengths of the region, as determined by the Innovation Platform Twente (IPT): food, health, high-tech systems & materials, safety, and construction. IPT comprises representatives of regional governments, educational, and research institutions, and companies. The thematic focus of the region is only partly aligned with the thematic focus of the university that defines nanotechnology, medical technology, ICT and process technology as its core activities.

Important regional actors include the University of Twente with its MIRA and MESA+ institutes, the Knowledge Park Twente with over 700 university spin-off companies, Innovation Platform Twente, multinational industries (such as Ten Cate, Thales, TKH, Grolsch and Vredestein) and the construction sector. They all play an important role in the regional innovation of Technology Valley. Since many years the University of Twente has a strong focus on creating spin-off companies and is very successful in terms of quantity. However, there is less

successful acquisition of companies to the region, these companies fail to make the Gazella leap, therefore remaining rather small.

**Table 2.** A SWOT analysis of the Food Valley

*Technology Valley TPN Analysis*

Figure 5 presents the results for the third knowledge-intensive island of innovation 'Technology Valley' of East Netherlands, as compared with the Triangle hotspot.

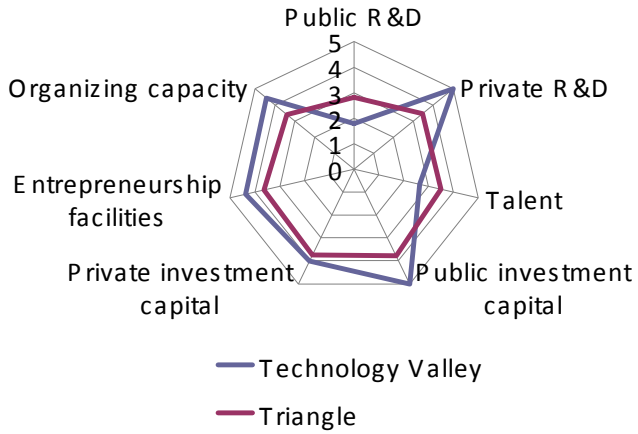



**Figure 5.** Technology Valley TPN analysis

Technology Valley scores relatively low on *'public R&D*' compared to other key factors in this cluster initiative. This can be explained by the fact that there are only a few large research institutes in the 'Technology Valley' with a substantial contribution on total public R&D, given the small-sized University of Twente with public R&D expenditures of approx. € 171 M and 9,000 students (which also explain the low score of the key factor '*talent*' and the lowest graduate retention in the region of 24 per cent) (See Appendix Table A and B). The R&D score spent in this region is based on an estimate based on available private R&D data of multinationals in the region.

Furthermore, Figure 5 shows that '*private R&D'* scores relatively high, because of the high contribution of multinationals in the region, such as Thales, Stork and Ten Cate.

Figure 5 also shows that the factor '*public investment capital'* achieved a high score, because of a relatively high quantity of pre-seed (viz. investing in interesting ideas and entrepreneurs) and seed (viz. investing in a proof-of-concept, a solid business plan) funds. This

means that there is a healthy and intensive entrepreneurial culture in Twente that will be improved through a future technology fund.

Finally, the fifth promising key factor *'organizing capacity'* achieved a high score because of a relatively high level of employees in organizations such as 'Kennispark' and IPT. A better strategic alignment of tasks between these organizations can improve the innovation performance and organizing capacity in the Technology Valley and can ensure a sustainable competitive advantage in a dynamic environment.

In Table 3, from a qualitative and quantitative stakeholders analysis various findings are briefly summarized in the context of a systematic SWOT analysis for five key domains of interest in innovation and economy in the region Twente in the most important knowledge intensive cluster initiative 'Technology Valley'.

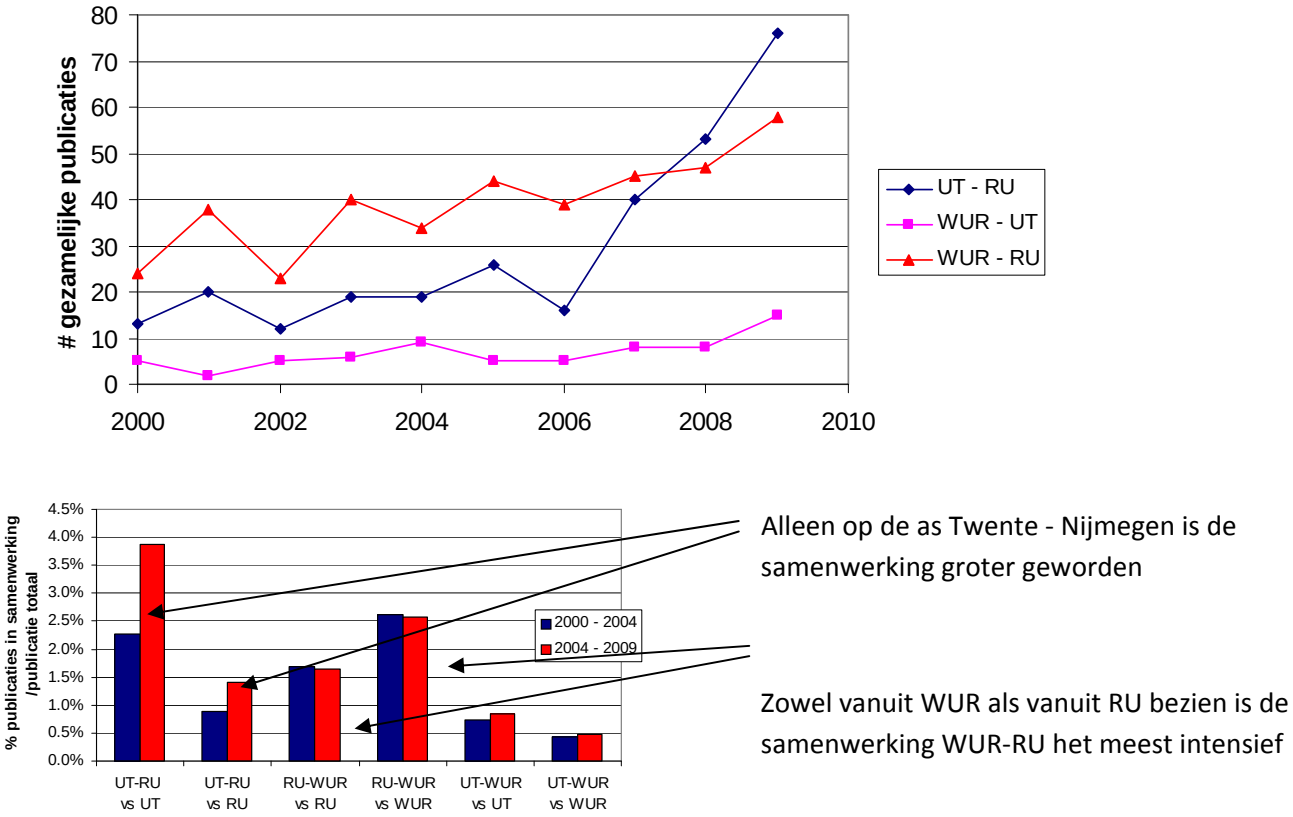
**Table 3.** A systematic overview of the various effects of the Technology Valley

| **Strengths** | **Weaknesses** |
|---|---|
| S1: Very successful spin-off strategy: ~700 spin-off companies from the University<br>S2: Entrepreneurial mentality amongst professors and researchers<br>S3: Intensive collaboration between University, Municipality and Province to promoting regional innovation<br>S4: Interdisciplinary research institutes of the University in line with international trend of cross-disciplinary innovation | W1: No single thematic focus point<br>W2: Spin-off companies do not make the Gazelle leap<br>W3: Regional industry and university not yet fully aligned<br>W4: Limited pool of marketing and commercial talent as required for the success of high-tech starters |
| **Opportunities** | **Threats** |
| O1: University is increasingly involved in Open Innovation collaborations with multinationals in the region and beyond (Boeing, Siemens, Thales and ten Cate).<br>O2: A focus on Med-Tech and Nanotechnology allows a sharper profiling of the university and the region.<br>O3: Commitment of regional industry and focused investment capital can stimulate Gazelle leaps of young starters. | T1 Absence of a thematic focus makes the region less attractive both to businesses and (inter)national top researchers<br>T2: The many actors and stakeholders in the regional innovation area render the system diffuse and potentially less efficient. |

### 3.5 Scientific bilateral collaboration within the Triangle

In order to make the leap from island of innovation to creative hotspot, it is amongst others essential to increase the functional and spatial synergy between the islands and to enhance bilateral collaboration. In this section we will concisely assess synergy and collaboration between the Triangle universities. Figure 6 shows bilateral cooperation in the scientific field between the universities within the Triangle hotspot. Collaboration between the universities of Twente and Nijmegen is prominent, primarily in the field of medical technology with an intensive collaboration on the theme ‘minimal invasive chirurgy’ and a synergy on the theme ‘micro- and nanotechnology’. In recent years the intensification of collaboration in the health field is mainly due to greater focus on this theme (Twente developed its Med Tech and Technical Medicine Studies and Nijmegen initiated the clustering initiative Health Valley) and intensified collaboration between the universities on these topic for reasons of complimentarily.

In addition, Figure 6 presents results of the collaboration between Wageningen and Nijmegen, which occurs particularly in the area of biochemistry and ecology. Collaboration between Twente and Wageningen is envisioned to increase in the field of bio-fuels and with a synergy in the field of nanotech and food.




*Source: ISI Web of Knowledge*

**Figure 6.** Scientific collaboration within the Triangle

In terms of university culture and profile, it is fair to say that Nijmegen is more of a classical university, while Twente and Wageningen have a strong focus on applied research, knowledge valorization and entrepreneurship stimulation. This is testified by the amount of patents, particularly when placed in comparison to the amount of scientific publications (see Table 4) and the ranking of the universities in terms of public-private collaborations (see Table 5).

Table 4 shows that both Twente University and Wageningen University have four times more patents per publication than Nijmegen University. This may partly be explained by the fact that the majority of studies of the universities of Twente and Wageningen are concentrated in the field of natural sciences, while Nijmegen University also, amongst other, has a philosophy, arts, theology and law faculty. Thus, Twente and Wageningen have a much stronger focus on applied research involving private partners (for which patents are a good indication). A similar picture

appears from Table 5, where Twente and Wageningen both hold a higher ranking when it comes down to public-private research publications, and where Twente is in the top 10 of the world regarding public-private publications in this field.

It might thus be concluded that efforts to increase collaboration within the Triangle hotspot at university research level are beginning to bear fruit. Differences in university culture may result in synergy on a number of issues. In addition, the cities of Enschede (in Twente) and Arnhem (close to Nijmegen) have additional professional higher education institutions that educate students up to a bachelor level (internationally also addressed as university of applied science, but in many European mainland countries not considered as such) including performing arts academies. Thus, as a whole, the region possesses all elements for transforming itself into a creative hotspot.

**Table 4.** Number of patents per university within Triangle and the relationship with the number of publications.

| University | # patents 2000 - 2010 | % patent/publication |
|---|---|---|
| Twente | 35 | 0.4% |
| Nijmegen | 26 | 0.1% |
| Wageningen | 57 | 0.4% |

*Source: World Intellectual Property Organization*

**Table 5.** Research Cooperation Scoreboard based on % public-private research publications

| University | All Sciences | Physics and Math | Medical and Health sciences | Life Sciences and Agriculture | Engineering-Science and ICT | Social and Behavioural Science |
|---|---|---|---|---|---|---|
| Twente | 11-25 | 51-100 | 1-10 | 1-10 | 101-200 | 51-100 |
| Nijmegen | 201-300 | 101-200 | 201-300 | 51-100 | 301-400 | 26-50 |
| Wageningen | 26-50 | 101-200 | 400+ | 1-10 | 400+ | 201-300 |

*Source: CWTS University-Industry Research Cooperation Scoreboard 2009-2010*

## 4. Benchmarking Three International Regions

It will be interesting to compare the region of East Netherlands with a number of other regions in Europe that are comparable in nr. of inhabitants (Oresund & North Brabant), innovation focus (Flanders and Oresund) and country (north Brabant) in order to understand the potential of the region under consideration. Again the TPN model will be used for a comparative analysis of East Netherlands against three other regions, namely Øresund (covers the South of Sweden and the East of Denmark), Noord-Brabant (a region in South Netherlands with Eindhoven as its most important science- and innovation base) and Flanders in Belgium.

- *Region Øresund*

The Øresund Region is located at the geographical periphery of Sweden, and comprises the Skåne county in the South of Sweden and on the Danish side Sjælland with its surrounding islands, the Greater Copenhagen region and the rural counties of Vestsjælland, Storstrøms, and Bornholm. The region ranks first with the highest 'well-educated population' of North Europe, and is recognized by its prominent 'food' and 'pharmaceuticals' related industries, universities and research institutes. Important key players in the regional innovation system of Øresund include the University of Lund and the University of Copenhagen, the Technical University of Denmark, the Swedish University of Agricultural Sciences and the Royal Veterinary and Agricultural University, the biocluster 'Medicon Valley', and multinationals such as Novo Nordisk, Lundbeck, AstraZeneca and LEO Pharma.

- *Region Noord-Brabant*

Noord-Brabant is predominantly located in the South of Netherlands. It is the only Dutch province that satisfies the Lisbon-target of 3% of GDP investment in R&D. The South-East part around the city of Eindhoven is more focused on high-tech systems, life sciences and food & nutrition, while the South-West part of the region is more focusing on new energy, logistics and maintenance. Important key actors in the regional innovation system of Noord-Brabant include Technology University Eindhoven, Brainport in Eindhoven, Brabantse Ontwikkelings Maatschappij (BOM), private firms such Philips, MSD and ASML, as well as the high-tech manufacturing industry.

- *Region Flanders*

The Flemish region is one of the three official regions of Belgium and occupies the northern part of the country. Core cities include Antwerp, Leuven and Gent. Antwerp is famous for its international harbour, Leuven and Gent (respectively the capitals of the provinces of Vlaams-Brabant and Oost Vlaanderen) are historical university towns and are focusing on e.g. biotechnology, semiconductor technology and tourism. Important players in the regional innovation infrastructure of the Flemish Region include the Universities of Gent and Leuven, IMEC, the Flemish institute for Biotechnology, Leuven R&D, and science parks in Haasrode, Arenberg and Beerse.

In Figure 8 we present the results of the multi-parameter TPN analysis of the four regions. The figure shows that the Øresund and East Netherlands achieve the highest score on the first item *'public R&D',* as compared with the other regions, mainly due to the presence of many

universities in Øresund, and the availability of high public R&D investments in research institutes in East Netherlands.

However, East Netherlands achieves a low score on '*private R&D'*, because of the few large multinationals that contribute significantly to private R&D in the region. Noord-Brabant achieves a high score, because of the many large multinationals, such as Philips, ASML and MSD. The region Øresund delivers top performance with a private R&D investment of approx. 5,010 M€ (3.9 per cent of the GRP).

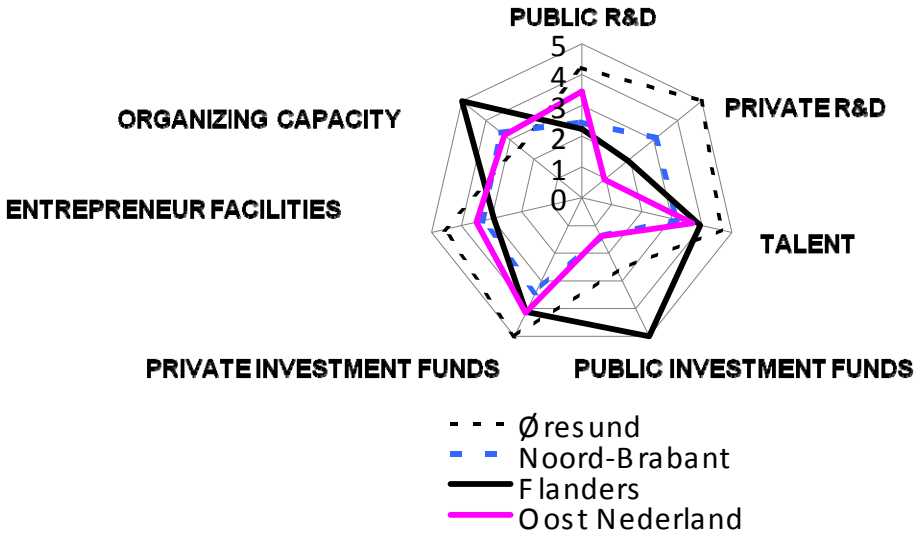



**Figure 8.** Comparative results of the four regions Øresund, Noord-Brabant, Flanders and East Netherlands

Flanders achieves a high score on *'public investment capital'*, because of the availability of large funds (approx. 836 M€), followed by the region Øresund with approx. 416 M€ investment capital, while, East Netherlands and Noord-Brabant perform poor on this factor.

Figure 8 shows that Noord-Brabant performs inferior on '*private investment capital'*, because of private investors (business angles) organization is lacking. The region Øresund outperforms the other regions on this key factor, because of the high number of employees in the financial sector. The Øresund region also performs best on the factor '*entrepreneurship facilities'* with a presence of 8 Science Parks. Flanders appears to have the highest *'organizing capacity'*.

Regarding private investment capital; we included the size of the financial sector in our assessment. It should be mentioned however that Flanders and Øresund comprehend capital

cities with a large financial sector, while for Brabant and East Netherlands this is largely located out of the regions, in Amsterdam.

## 5. Policy Lessons

Innovation policy is not a generic and uniform policy strategy, but calls for tailor-made creative policy initiatives, in which specificities such as locational advantages, presence of knowledge centres, role models of successful companies, leadership models, successful innovation clusters, favourable quality of life and financial/fiscal support systems play an important role. But most of all, knowledge synergy through spatial connectivity and industrial or institutional networks appears to be a critical success factor. This lies also at the heart of the concept of 'creative hotspots' highlighted in the present study.

A creative hotspot ensures that economic progress is rooted in a highly-skilled labour force, in openmindedness of people through a favourable synergy of human and social capital, in a sense of social-ecological sustainability, and in a permanent search for competitive advantages through an exploitation of the 'animal spirit' for entrepreneurship. Creative hotspots may be seen as synergetic regional innovation clusters connecting knowledge, business, intermediaries, and the market. They are based on network externalities among complementary innovation areas and will act as engines for accelerated growth and new jobs. And hence, they will ultimately contribute to community well-being.

In the context of our empirical study on the innovation potential of East-Netherlands, it is clear that geographic connectivity is primarily a vehicle to generate added value from a thematic complementary clustering of new and innovative activities and initiatives. Most of these activities are naturally rooted in economic islands of innovation in the regions concerned and are not externally 'parachuted'. Such creative hotspots are open network constellations that may contribute to valorization of business and knowledge, through a cooperation with many stakeholders, both internal and external ('satellites').

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# Appendix. Data on Four Regions

**Table A:** Benchmarking of the regions: Øresund, Noord-Brabant, Flanders, and East Netherlands

| **RESOURCES** | **ØRESUND** | **NOORD-BRABANT** | **FLANDERS** | **EAST NETHERLANDS** |
|---|---|---|---|---|
| # inhabitants | 3,73E+06 | 2,44E+06 | 6,12E+06 | 3,09E+06 |
| GRP (Gross Regional Product) | 1,30E+11 | 8,04E+10 | 1,70E+11 | 8,69E+10 |
| # universities | 6 | 2 | 5 | 3 |
| Public R&D expenditures | 1 430 M€ | 241 M€ | 903 M€ | 1 090 M€ |
| Private R&D expenditures | 5 010 M€ | 1 930 M€ | 2 560 M€ | 6 50 M€ |
| Number of students | 165.000 | 51000 | 154451 | 94932 |
| % students / population | 4,42% | 2,09% | 2,52% | 3,07% |
| % population with higher education | 32,00% | 29,50% | 37% | 28,90% |
| # Incubators | 5 | 4 | 6 | 4 |
| # Science Parks | 7 | 1 | 5 | 3 |
| # Regional (pre)seed funds | 3 | 5 | 5 | 4 |
| Size public regional (pre)seed funds | 416 M€ | 32 M€ | 836 M€ | 88 M€ |
| Size financial sector | 56803 | 33700 | 71529 | 36439 |
| Size Economic development agency (# FTE) | 55 | 30 | 166 | 62,5 |
| Entrepreneurship societies | yes | yes | yes | yes |
| Business angel networks | yes | no | yes | yes |
| Shared innovative strategy | yes | yes | yes | yes |

**Table B:** Benchmarking of the Clusters: Health Valley, Food Valley, and Technology Valley

| **RESOURCES** | **Health Valley** | **Food Valley** | **Technology Valley** |
|---|---|---|---|
| # inhabitants | 3.02E+05 | 1.42E+05 | 3.59E+05 |
| GRP (Gross Regional Product) | 1.83E+10 | 6.80E+09 | 9.70E+09 |
| Public R&D expenditures | 4.02E+08 | 5.20E+08 | 1.71E+08 |
| Private R&D expenditures (estimate) | 3.17E+08 | 5.97E+07 | 2.36E+08 |
| Number of students | 45571 | 7457 | 25114 |
| % students / population | 15% | 5% | 7% |
| % population with higher education | 41% | 33% | 24% |
| # Incubators | 2 | 1 | 1 |
| Science Parks surface (in ha.) | 1.5 | 10 | 40 |
| # Regional (pre)seed funds | 3 | 5 | 5 |
| Public regional seed investment | 17 M€ | 12 M€ | 18 M€ |
| # preseed grants | 18 | 7 | 28 |
| Size Cluster Organisation Agency (# FTE) | 4 | 7.4 | 12 |
| Entrepreneurship societies | yes | yes | yes |
| Business angel networks | yes | yes | yes |

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